



PHYSIOCHEMICAL CHARACTERISATION OF SOME LOCAL AND ELITE DATE PALM
(*PHOENIX DACTYLIFERA* L.) CULTIVARS IN GUJARAT

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ARTICLE INFO

Article History:

Received 13th September, 2018

Received in revised form 11th

October, 2018

Accepted 8th November, 2018

Published online 28th December, 2018

Key words:

Phoenix dactylifera L., cultivars, variation, physiochemical, Pericarp

ABSTRACT

Date palm (*Phoenix dactylifera* L.) a dioecious species is well-known high energy value crop with a very good nutritional value compared to the tropical and sub-tropical fruits. India where they are widely cultivated in districts like Kutch in Gujarat. Many cultivars are grown in Kutch; because each date is differed medicinally also date palm fruits are of great importance because they are rich in many active constituents. In the present study physiochemical variations in different cultivars (5 local and 4 elite varieties from Kutch) have been assessed to evaluate the possible differences among the tested cultivars. Characteristic features like titratable acidity, moisture content, total soluble solids, juice content etc. have been evaluated and compared. Significant variations have been observed in the different cultivars which add precise evidence to taxonomic identity of the studied 9 cultivars of date palm fruits. Fruit quality was determined and compared using different physiochemical properties (Juice content, Moisture content, Acidity, TSS, TSS and acidity ratio) of the fruits. The TSS/ acidity ratio is a key characteristic determining the taste, texture and feel of fruit segments. TSS is highest in KCL09.1 and high no of TSS is responsible to produce less acidic and sweet fruit. Acidity is also lowest in KCL09.1 which provides less sour taste to fruit. On the basis of the different parameters studied KCL09.1 cultivar was observed to be the best cultivar in terms of quality.

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INTRODUCTION

Date palm (*Phoenix dactylifera* L.) has long been one of the most important fruit crops in the arid regions of the Arabian Peninsula, North Africa, and the Middle East. These cultivars of date palm are identified commonly by wide range of morphological features that described trees and fruits (Nixon, 1950; Zaid and de Wet, 2002; Elhoumaiziet al., 2002; Osman, 2002). Date palm (*Phoenix dactylifera* L.) is a perennial and diploid ($2n = 2x = 36$) genera which is the single member of tribe Phoeniceae, monocotyledonous family Palmae. *Phoenix* meaning purple or red or in Greek language it refers to the color of fruits and *dactylifera* means finger referring to the fruit shape. Date palm is dioecious, meaning it has separate female and male trees. The number of date varieties globally exceeds 2000 but <10% of these are described regarding their characteristics (Ghnimi et al. 2017). The date palm has a lot of medicinal uses which includes cold, fever, cystitis, edema, thore throat, bronchial catarrh, liver cancer, low sperm count and abdominal trouble to mention few. Seeds are used in a paste to relieve ague. Its gum (exudes from wounds) is used for the treatment of diarrhoea, it can counteract alcoholic

intoxication, and its roots are used against tooth ache and pollen supply oestrogens. Fruit quality is influenced by size, color, texture, cleanliness, freedom from defects (sunburn, insect damage, sugar migration to surface, fermentation), and the effects of decay-causing pathogens. Date fruit are high-energy food sources with 72% to 88% sugar content at maturity. During the Khalal stage, nearly all (80% to 85%) of the sugar is sucrose. As ripening progresses, the sucrose is hydrolyzed into reduced sugars such as glucose and fructose. The date fruit goes through four distinct ripening stages. These four stages are usually referred to in terms derived from Iraqi Arabic as “Kimri,” “Khalal” (sometimes referred to as “Bisr”), “Rutab,” and “Tamar” to represent the immature green, the mature full coloured, the soft brown, and the hard raisin-like stages respectively (Reuveni, 1986). Water content is 75% to 80% in young fruit, decreasing to 40% to 60% at the beginning of ripening, and decreasing rapidly later. The sugar content is about 20% dry matter during early Kimri, increasing steadily to 50% dry matter at the beginning of Khalal, and then accumulating at a faster rate until reaching 72% to 88% of dry matter at maturation (Reuveni, 1986). Date fruits are considered as a good source of sugars; it provides natural sugars in form of glucose and fructose which can easily absorb by the human body. Date fruits contain 6.5 – 11.5% total dietary fibre (of which 84-94% insoluble and 6-16% soluble dietary fibre), about 1% Fat, 2% proteins and 2% ash and is a rich source of phenolic antioxidants. “Tamar stage” also called

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as the full ripe stage is the stage when the dates are fully ripe and they completely change the colours from yellow to dull brown or almost black. The texture of the flesh is soft. The skin in most varieties adheres to the flesh and wrinkles as the flesh shrinks. At this stage, the date contains maximum total solids and has lost most of its water to such an extent (below 25% down to 10% and less) that it makes the sugar water proportion sufficiently high to prevent fermentation. This is the best condition for storage. The average relative decrease in fruit weight during this stage is 35%. Variation in the chemical composition of the fruit influences their nutritional value, sensory quality and industrial utilization. Because of genetic differences and agro ecological conditions, dates show a wide variation in final appearance and quality as perceived by consumers. The date palm is mainly propagated vegetatively through offshoots but also by tissue culture or through seed. It is important that a grower aims to produce an acceptable balance of TSS and fruit acidity. The TSS/ acid ratio is a key characteristic determining the taste, texture and feel of fruit segments. It contributes towards many fruits their characteristic flavour. It is also an indicator of commercial and sensory ripeness. The moisture content, refractive index and other physiochemical parameters varied widely between different cultivars. Most dates are consumed at the Rutab (semi ripe) and Tamar (fully ripe) stages, with little or no processing. Date fruits in Kutch are harvested at the Rutab stage itself because by the time Tamar stage is attained monsoon begins and the fruits are spoiled leading to economical disadvantages and losses.

This present study was aimed to analyze the physiochemical characteristics of the date palm fruits and their application in identification of the best date palm cultivars collected from Gujarat.

MATERIALS AND METHOD

Two sets of date palm fruit bunches were collected and analysed in the present study. The samples selected were (1) Elite varieties (2) Local varieties in market. Date fruit samples designated as A, B, C, D, E varieties were collected from the vendors in the local market in Vadodara. The elite varieties (KCL141, KCL143, KCL119, and KCL09.1) were collected from Kutch crop limited from the date palm cultivated orchard in Kutch. The fruit samples were collected throughout the date palm fruiting seasons (2015-2016) at khalal maturity stage.

50 fruits of each variety were cleaned to remove any foreign matter and packed in labelled polythene bags and stored in refrigerator till analysis. Physical features were analysed. The following data were recorded:

Physiochemical parameters

Moisture content, dry matter, total soluble solids (TSS) and titratable acidity were determined according to Anon (1990a) methods. Fruit samples were cleaned and seeds were removed. Date flesh were cut into pieces and dried at 60-70°C. The moisture and dry matter content percentage were calculated using the following equations:

$$\text{Moisture \%} = \frac{\text{Weight before drying} - \text{Weight after drying} \times 100}{\text{Weight before drying}}$$

$$\text{Dry matter (\%)} = \frac{\text{Average dry weight (g)} \times 100}{\text{Average fresh weight}}$$

Moreover, Total soluble solids (TSS) content was determined in the fruit juice using a hand refractometer. Sugars are the major soluble solids in fruit juice. Other soluble materials include organic and amino acids, soluble pectin, etc. Soluble solids concentration (SSC%, °Brix) can be determined in a small sample of fruit juice using a hand-held refractometer.

However, Fruit acidity was determined using 10 ml of fruit juice (a known fruit flesh weight blended in known water volume) which were titrated against sodium hydroxide using phenolphthalein as an indicator according to the official methods and the Titratable acidity was calculated as malic acid. Results expressed as percentage acid:

$$\text{Percentage acid} = \frac{\text{Titrant} \times \text{Acid factor} \times 100}{10 \text{ ml juice}}$$

$$\text{The sugar acid ratio} = \frac{\text{°Brix value}}{\text{Percentage acid}}$$

The juice content is determined by cutting the fruit in half crosswise and squeezing each half to extract all the juice with an extractor or a juice press. The extracted juice is then filtered through muslin cloth, fine filter or strainer. The juice content is calculated in following way:

$$\text{Juice percentage} = \frac{\text{Total weight of juice (gm)} - \text{beaker weight (gm)} \times 100}{\text{Total weight of fruit (gm)}}$$

RESULT

Biochemical properties

The chemical composition tests were carried out to determine moisture content, titratable acidity, total soluble solids and TSS/Acidity ratio values of different date palm cultivars during 2016 and 2017 seasons (Table 1).

Table 1 Biochemical parameters of the different cultivars

Parameters Cultivars	Moisture content % of fruit	Moisture content % of seed	Total soluble solids	% Acid	Sugar acid ratio
A	67.97	45.45	17.5	0.32	54.68
B	71.44	34.02	18.5	0.23	80.43
C	63.09	28.43	18	0.21	85.71
D	70.74	31.38	23	0.56	41.07
E	72.24	35.92	19.5	0.38	51.31
KCL141	55.97	36.47	20	0.54	37.03
KCL119	65.79	34.95	26	0.31	83.87
KCL143	58.35	34.06	24	0.40	60.00
KCL09.1	64.29	35.0	30.5	0.23	132.6

KCL141 cultivar had the lowest value of moisture content of fruit by 55.97% in comparison with other cultivars while, E, B and D cultivars had the highest values by 72.24, 71.44 and 70.74% respectively. The seed moisture content was highest in cultivar A (45.45%) while lowest value was seen in cultivar C (28.43%). There was no significant different in moisture content % of KCL119 and KCL09.1 by 34.95 and 35%. KCL09.1 cultivar had the highest value of total soluble solids (TSS) of fruit by 30.5% than other cultivars followed by B (18.50%), C (18.00%), D (23.00%), E (19.50%), KCL141 (20.00%) and KCL119 (26.00%) while, A cultivar had the lowest value by 17.50%. TSS/ acidity ratio is a very important parameter of fruit quality. It was noticed that KCL09.1 cultivar had the highest value of TSS/Acidity ratio (132.6) followed by A (54.68), B (80.43), C (85.71), D (41.07), E (51.31), KCL119 (83.87) and KCL143 (60.00) while, KCL141 had the lowest value by 37.03. In this respect, this might be referred to the

fact that KCL141 is a semi-dry date. The juice content is also important to determine fruit quality. The juice content % was highest in KCL143 cultivar by 42.32 and lowest value was seen in A cultivar by 25.93%. There was no significant difference between juice content of D and C cultivar (27.37 and 27.33% respectively).

DISCUSSION

Quality of fruits (flesh) depends on its external (i.e. colour & firmness) and internal characters via: TSS or Brix, Total acid, TSS/Acid ratio and juice content characters (Purvis, 1983). The factors influencing fruit quality characteristic include type of cultivar and stage of maturity. Harvesting of fruits at proper stage of maturity is of principal importance for attaining desirable quality and to attain its proper nutritive benefits. The development of date fruits is divided into three stages Khalal, Rutab and Tamar. Fruits are harvested at the fully ripened Tamar stage that is after the development of TSS of 60-70 Brix that are edible at this stage.

The Total Soluble Solids (TSS) content was obtained by assessing the Brix of the fruit. The TSS measures and includes the carbohydrates, organic acid, proteins, fats and minerals of the fruit. It represents from 10-20% of the fruits fresh weight and increases as fruit matures to produce a less acidic, sweeter fruit. A high level of acidity which is common in under ripe fruit makes the fruit taste sour. Conversely over ripe fruits have very low levels of fruit acid and therefore lack characteristic flavour.

The chemical composition of different date palm cultivars has been reported by several investigators (Hussein et al., 1979; Abdalla et al., 1996; Youssef et al., 1999; Attala et al., 2001; AL-Eid, 2006; Al-Farsi et al., 2007 & Alkhateeb, 2008). Abdalla et al. (1996) cited that commercial grading of dates is based principally on the physical characteristics and general appearance of the fruit, moisture and sugars contents. Hussein et al. (1979) classified the dates according to their moisture contents into soft dates which usually possessed moisture content more than 30% and had low sucrose and this must be eaten fresh. Semi-dry dates which had a moisture content between 20% and 30% and had a low sucrose content and finally dry dates contained less than 20% moisture content and this type of dates require high temperature and sun level for maturation and contained approximately equal quantities of sucrose and reducing sugars. In all this above cultivar, moisture content is more than 30% so it must be eaten fresh. Percentage acid also determines fruit quality. In C cultivar %acid is lowest so it is not sour in taste but in D cultivar, %acid is highest so it is slightly sour in taste. The juice content is highest in KCL143 by 42.32 which indicate it is use as a table food. Such study might add precise evidence to taxonomic identity of nine female cultivar of date palm.

CONCLUSION

Biochemical properties of the fruit also determine its quality. The TSS/ acid ratio is a key characteristic determining the taste, texture and feel of fruit segments. KCL09.1 had the highest value of TSS/ acid ratio. TSS is highest in KCL09.1 and high no of TSS is responsible to produce less acidic and sweet fruit. Acidity is also lowest in KCL09.1 which provides less sour taste to fruit. Juice content is highest in KCL143. Overall on the basis of the different parameters studied KCL09.1 cultivar was observed to be the best cultivar in terms

of quality. All the elite varieties studied showed quantitative characteristics to be more than the local varieties.

Acknowledgments

The authors are highly indebted to Prof J.J. Shah for initiating this topic on morphometric study on the date palm cultivars in Gujarat. This is the first study in Gujarat. The authors are thankful to the Kutch crop limited for providing elite varieties fruits.

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How to cite this article:

Minal D Bambhaniya and Susy Albert (2018) 'Physiochemical Characterisation of Some Local and Elite Date Palm (Phoenix Dactylifera L.) Cultivars in Gujarat', *International Journal of Current Advanced Research*, 07(12), pp. 16493-16496. DOI: <http://dx.doi.org/10.24327/ijcar.2018.16496.3051>
